Report No. NPS D-256

Annual Data Summary

ACADIA NATIONAL PARK

2001

National Park Service
Gaseous Air Pollutant Monitoring Network

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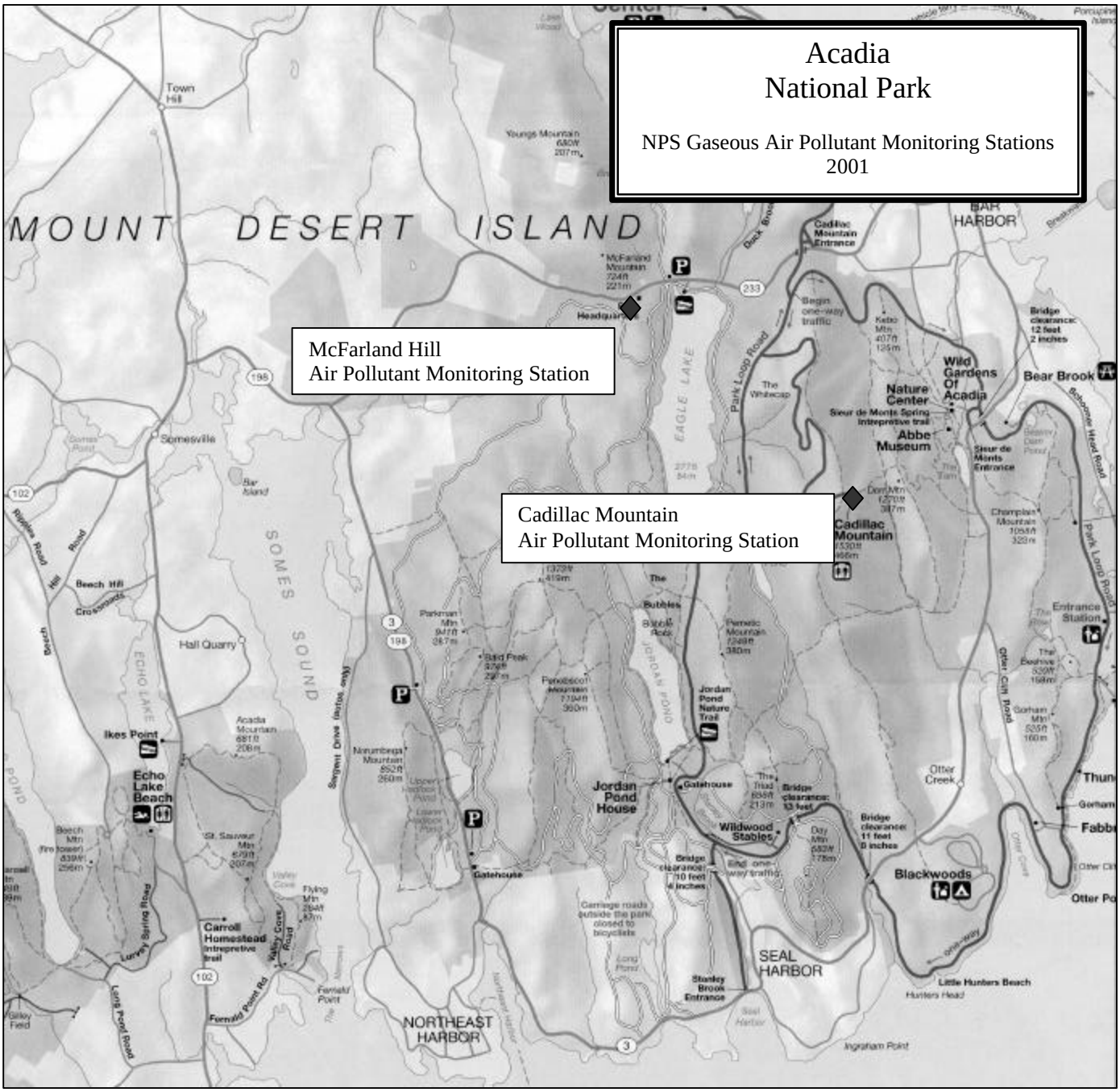

The state of Maine and the National Park Service maintained two air pollutant monitoring sites in Acadia National Park during 2001. Data from each site are summarized in this report.

Annual Data Summary

ACADIA NATIONAL PARK
Cadillac Mountain

2001

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At Acadia National Park, the ARD specifically recognizes Bob Breen and Bill Gawley of the State of Maine Department of Environmental Protection Bureau of Air Quality for performing the technical and administrative skills required to help produce the data presented within this report.

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1.0 INTRODUCTION

1.1 THE NATIONAL PARK SERVICE GASEOUS POLLUTANT MONITORING NETWORK

Gaseous air pollutants, including ozone and sulfur dioxide, are of concern to the National Park Service (NPS). Pollutants like these can affect park unit biological resources as well as the health of park unit residents and visitors. The NPS established a gaseous pollutant monitoring program for several pollutants linked to effects on NPS resources. This program was designed to meet certain resource management objectives.

The primary objective of this monitoring program is to establish the status and trends of park unit air quality conditions and to determine if a park unit is exceeding the National Ambient Air Quality Standards established by the U.S. Environmental Protection Agency (EPA) to protect public health and welfare. In addition, such monitoring is designed to detect changes or trends in pollution levels over time. A monitoring station may also be established if there is documented biological injury due to air pollution in a park unit. Information on ambient air pollution levels is an important part of research on effects of air pollutants on NPS resources, and can help confirm suspected causes of observed effects.

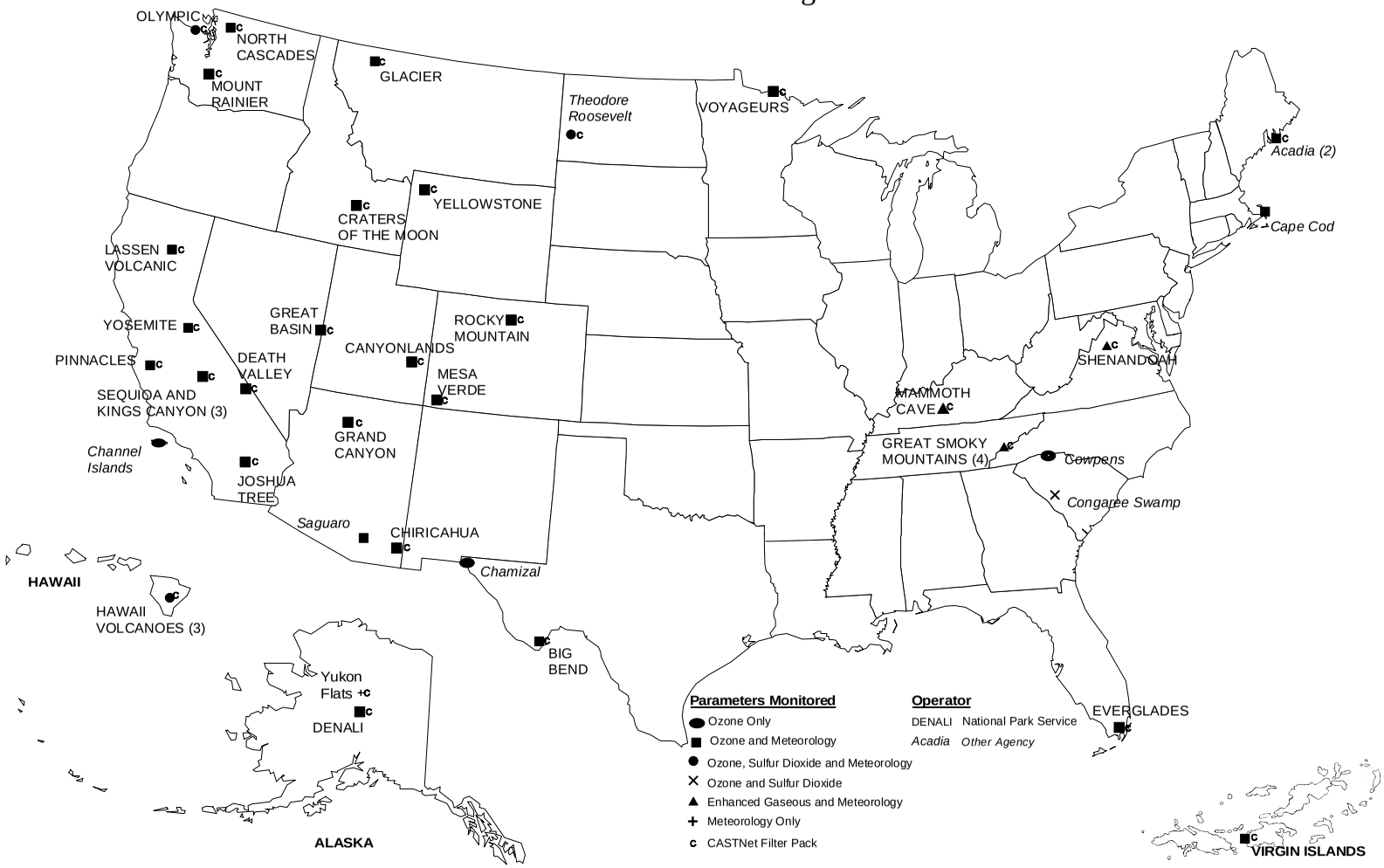
Other monitoring objectives call for the collection of data to support the National Park Service's required involvement in both the development of state air quality control plans, and the evaluation of permit applications for new or expanding air pollution sources wishing to locate near park units. The Clean Air Act gives federal land managers and superintendents an affirmative responsibility to protect air quality related values in Class I areas and to assess whether new sources will have an adverse impact on park unit resources and values. Information on air quality levels in NPS units can also be used to evaluate the performance of atmospheric models that simulate how pollutants are transported into park units and predict impacts on the park unit caused by air pollution sources.

The National Park Service Gaseous Pollutant Monitoring Network site locations and measured parameters collected in this reporting year are shown on the map on the following page. During this reporting period, 45 monitoring sites in 36 units of the National Park System had some combination of ozone, sulfur dioxide, meteorological, and CASTNet dry deposition monitoring. Monitoring methods and quality assurance procedures used in the national park network meet the applicable 40 CFR Part 58 EPA requirements. This allows for the direct comparison of NPS collected data with that collected by the EPA, and state and local air pollution control agencies. Data collected by this network are incorporated in the EPA Aerometric Information Retrieval System (AIRS) database which is a national database of all air quality data collected throughout the country. These data are also stored in the NPS Air Resources Division's Information Management Center (IMC) that allows for easy access and analysis of data.

This report includes a variety of data summaries for data collected at an individual monitoring site at a national park unit during this reporting period. These summaries highlight the average range and frequency of the data collected during the year. A PC-compatible diskette containing a digital copy of all data collected during the year and data summary products included in this report is available. Individual reports are generated for each site where monitoring was conducted in the national park network.

NATIONAL PARK SERVICE
GASEOUS POLLUTANT MONITORING NETWORK

2001 Monitoring Sites



1.2 ACADIA NATIONAL PARK

Acadia National Park, a Class I area, is located along the coast of Maine in Knox and Hancock Counties. Its location and site specifications are presented on the next page.

The mandate from the United States Congress states Acadia National Park was established "...to conserve the scenery and the natural and historic objects and the wildlife therein, and to provide for the enjoyment of the same in such a manner and by such means as will leave them unimpaired for the enjoyment of the future generations." The purpose of Acadia is to perpetuate the historical traditions and natural history of a portion of the Maine coastline and to offer visitors an increased awareness of their American heritage.

Sieur de Monts National Monument was established by Presidential Proclamation in 1916. In 1919, the name was changed to Lafayette National Park and again in 1929 to Acadia National Park.

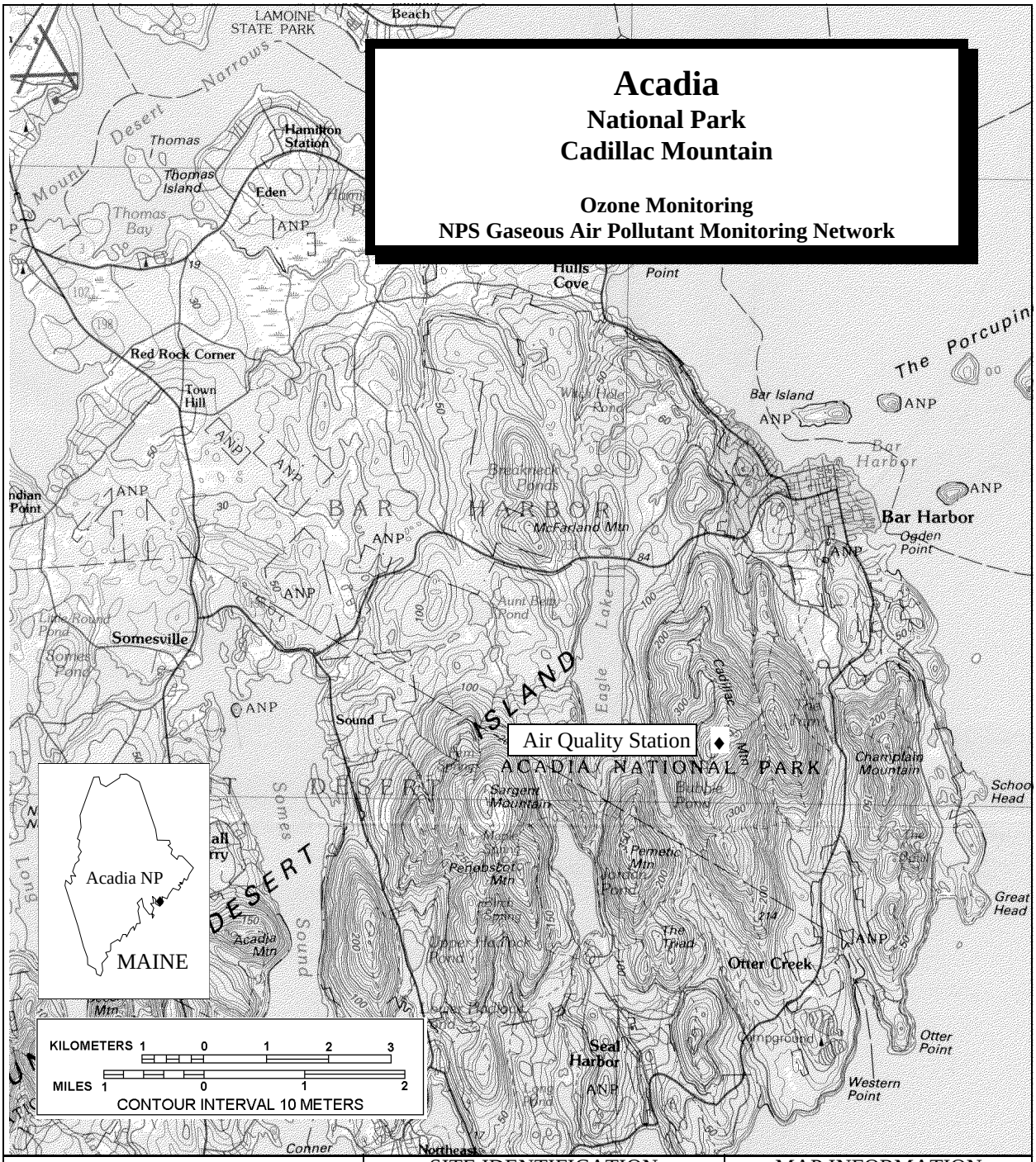
Acadia National Park conserves panoramas and scenic vistas of mountains, rocky coasts, islands and the ocean in a combination that is unequalled along the Atlantic coast. When viewed from seaside cliffs, islands along the coast spread out to the horizon. Behind the rocky shore, the rounded summits of glaciated mountains rise to 1,530 feet. Throughout the mountains are small clear lakes surrounded by spruce, fir and hardwoods. A major concern is residential and commercial development on private lands which threatens to encroach on park vistas offering views of forests, cliffs, and oceans.

The forests of Mount Desert Island have a special quality. The northern coniferous and temperate deciduous forests meet and overlap, bringing to the island an exceptional variety of trees, shrubs and herbaceous plant life. About 1,500 species of plants are found in Acadia, but the majority of these cannot be considered common. For example, scrub oak is only found on Acadia Mountain and a few nearby mountain slopes.

Recent research has found a number of native plants including broad-leaf aster (*Aster macrophyllus*), spreading dogbane (*Androsaemifolium*), black cherry (*Prunus serotina*), and white ash (*Fraxinus americana*) to be sensitive to ambient levels of ozone. Field surveys have confirmed the presence of foliar injury to some of these species growing under natural conditions at Acadia. Other research has indicated a positive correlation between ozone concentration and reduced tree-ring growth in several white pine stands in the park. There have also been a number of other biotic and abiotic agents identified that impact park vegetation including spruce budworm, gypsy moths, insects, and a fungus that produces needle injury to white pine.

Approximately 50 species of mammals and 327 species of birds have been reported in Acadia National Park, as well as amphibians and reptiles. The dominant mammals include raccoon, mink, skunk, red fox, harbor seal, beaver, snowshoe hare, white-tailed deer and harbor porpoise.

In addition to the issue of surrounding growth and development which encroaches primarily on water and visual resources, there are a number of air pollution related concerns. Acid deposition, ozone, mercury and other toxins including PCB's have all been identified as impacts to Acadia's flora, fauna, and hydrogeochemical resources.



SITE IDENTIFICATION	MAP INFORMATION
Site Abbreviation: ACAD-CM AIRS ID NO.: 29-009-0102	Mean Elevation: 466 m Longitude: 68°13'40"W Latitude: 44°20'50"N UTM Zone: 19 Easting: 561551m Northing: 4910512m Map Reference: Bar Harbor 44068-A1 1:100,000

INSTRUMENTATION

O_3 Analyzer	Wind Direction
Relative Humidity	Temperature
Wind Speed	Calibrator

2.0 DATA SUMMARY

2.1 OVERVIEW

Based on the site specifications during this annual reporting period, data summaries and statistics are provided in this section.

Data Collection Statistics
Acadia National Park
Cadillac Mountain

Final Validation

01/01/2001 - 12/31/2001

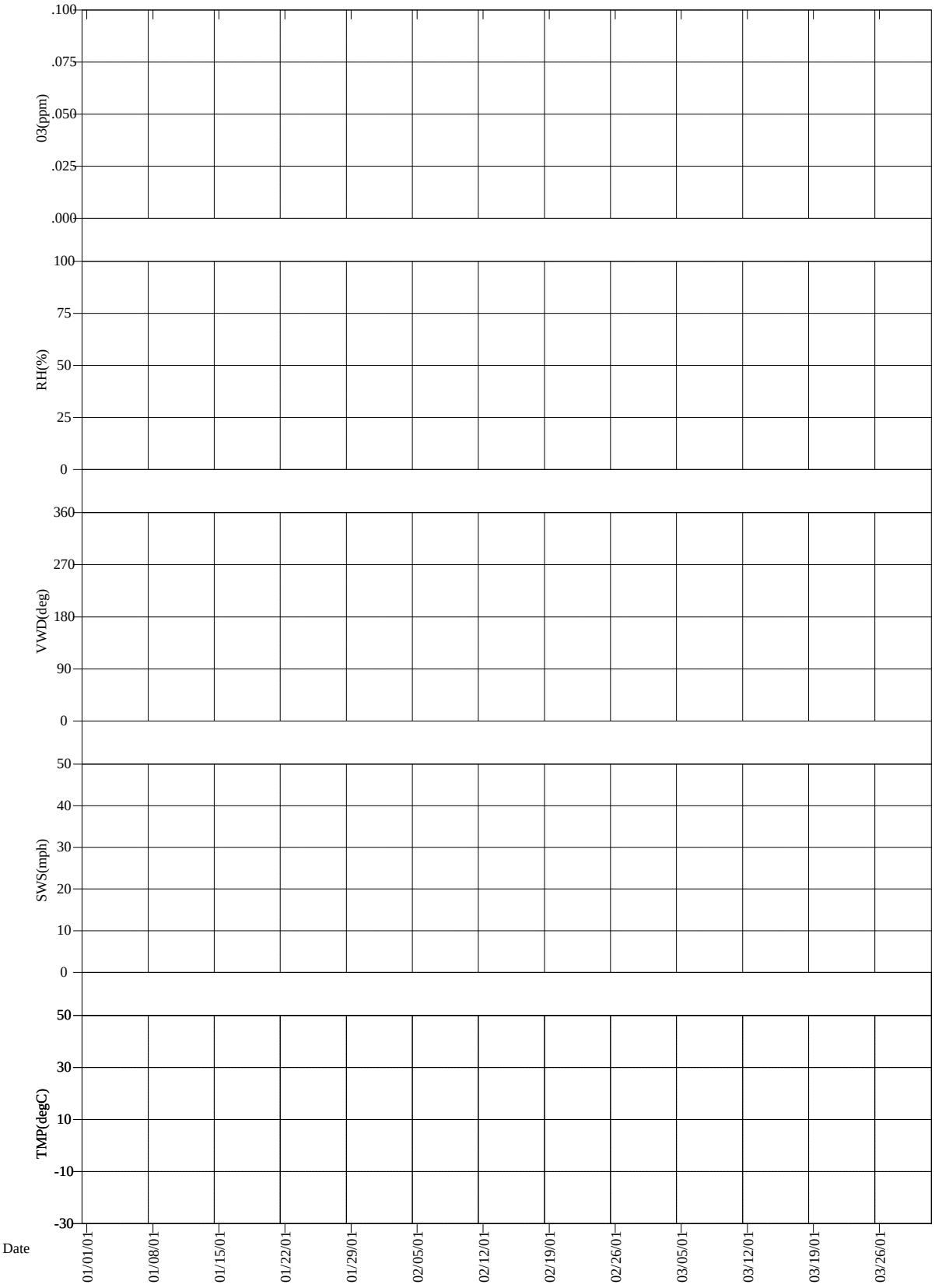
Parameter	Interval	Par Code	Data Recovery			Valid Data	
			No. Possible	No. Collected	% Collected	No. Valid	% Valid
Ozone Analyzer	hourly	O3	4392	4209	95.8	3556	81.0
Scalar Wind Speed	hourly	SWS	4392	4380	99.7	3552	80.9
Vector Wind Speed	hourly	VWS	4392	4380	99.7	3134	71.4
Vector Wind Direction	hourly	VWD	4392	4284	97.5	3134	71.4
Scalar Wind Direction	hourly	SWD	4392	4284	97.5	3134	71.4
Standard Deviation for Wind Direction	hourly	SDWD	4392	4284	97.5	3134	71.4
Ambient Temperature (aspirated)	hourly	TMP	4392	4391	100.0	2438	55.5
Relative Humidity	hourly	RH	4392	4391	100.0	2621	59.7

Notes: The percent valid is calculated against the number possible.
Automatic zeros and spans are performed daily on most ambient gas analyzers, therefore, no ambient data can be collected during this time. As a result, the maximum percent valid for ambient gas data typically can not be greater than 95.8.

Performance Goals:

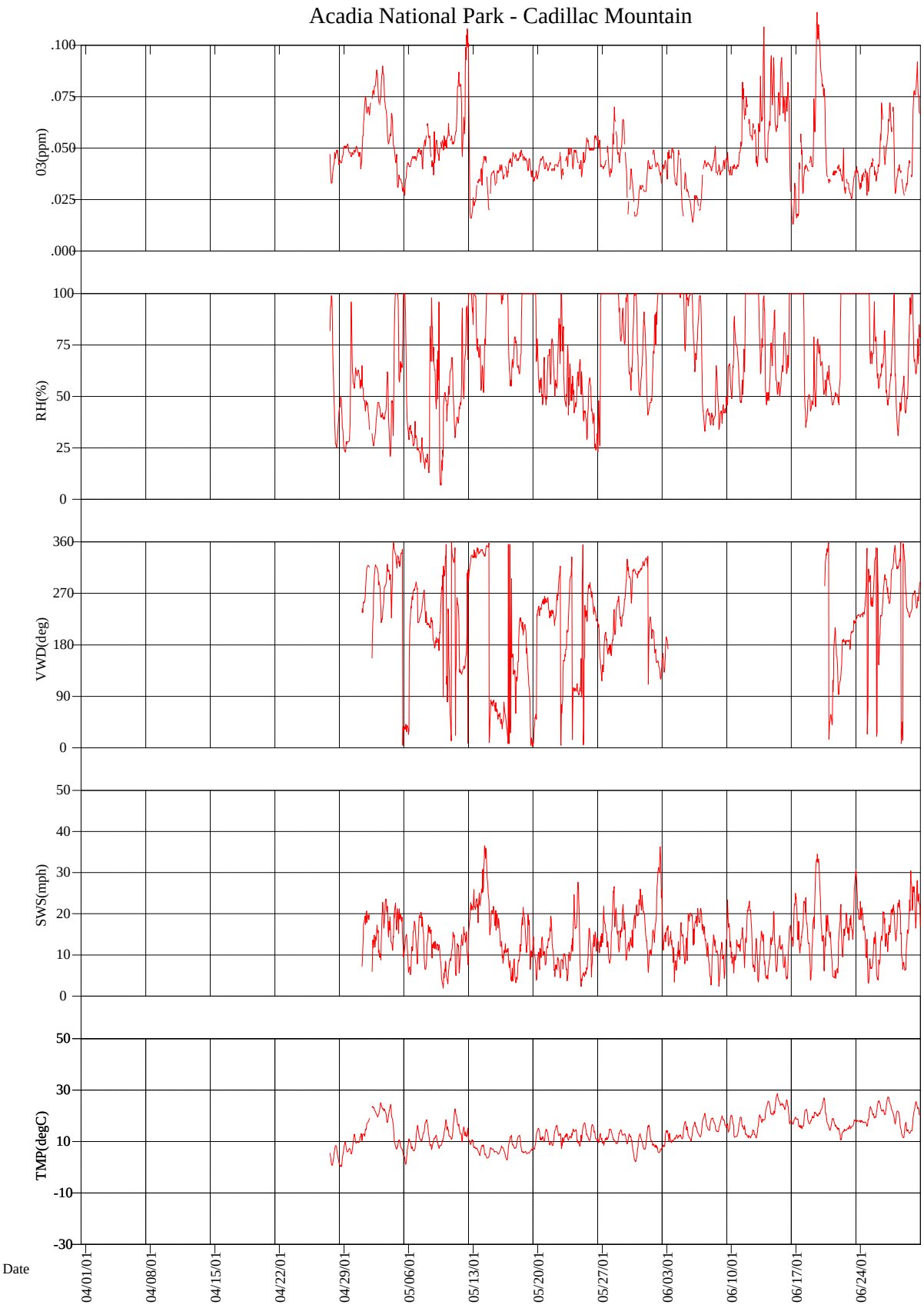
Quarterly Criteria:	Monthly Criteria:
100% of sites, >= 85% valid data capture	100% of sites, >= 60% valid data capture
90% of sites, >= 90% valid data capture	90% of sites, >= 75% valid data capture
80% of sites, >= 95% valid data capture	80% of sites, >= 85% valid data capture

Acadia National Park - Cadillac Mountain



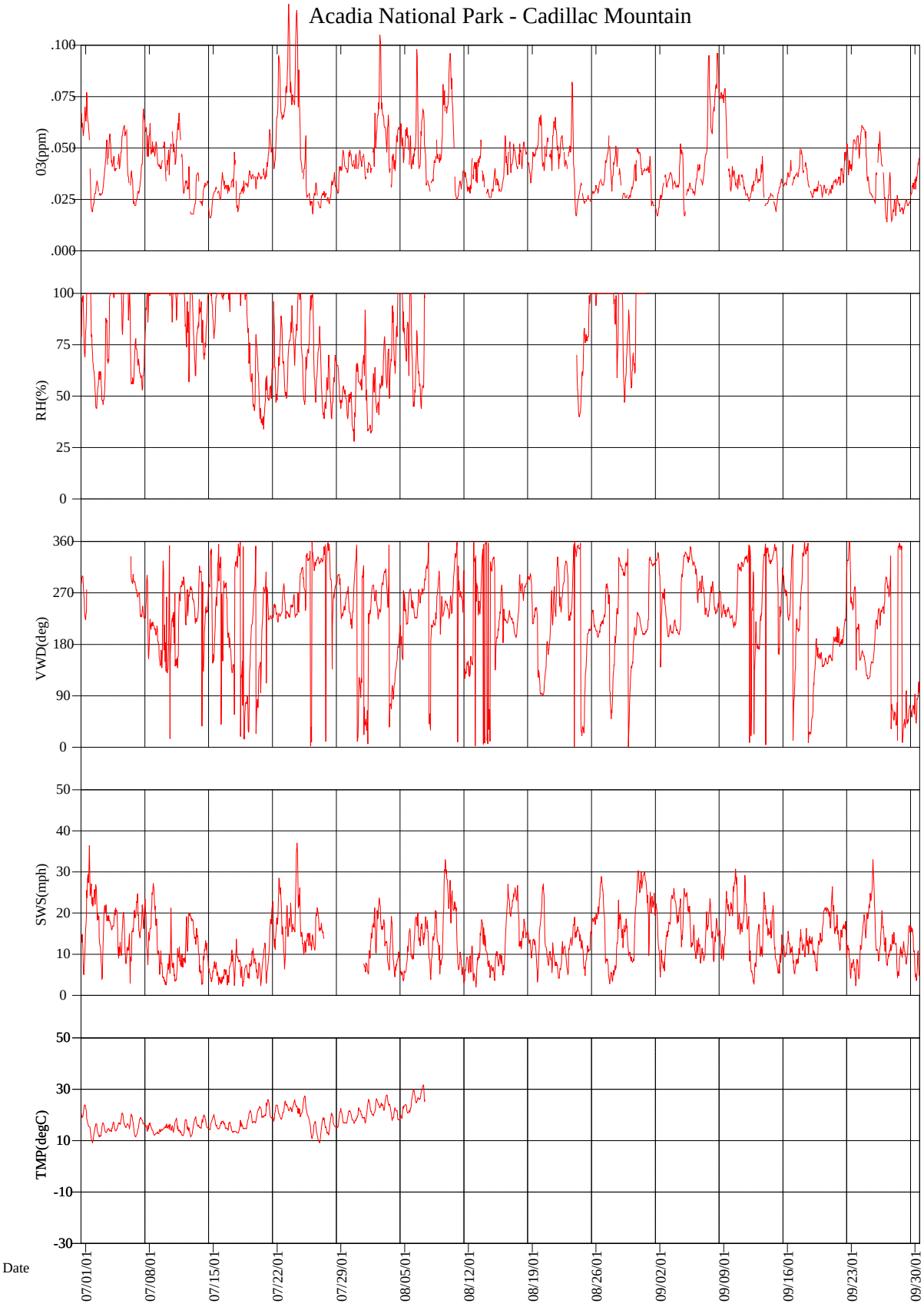
Final Validation

First Quarter 2001



Final Validation

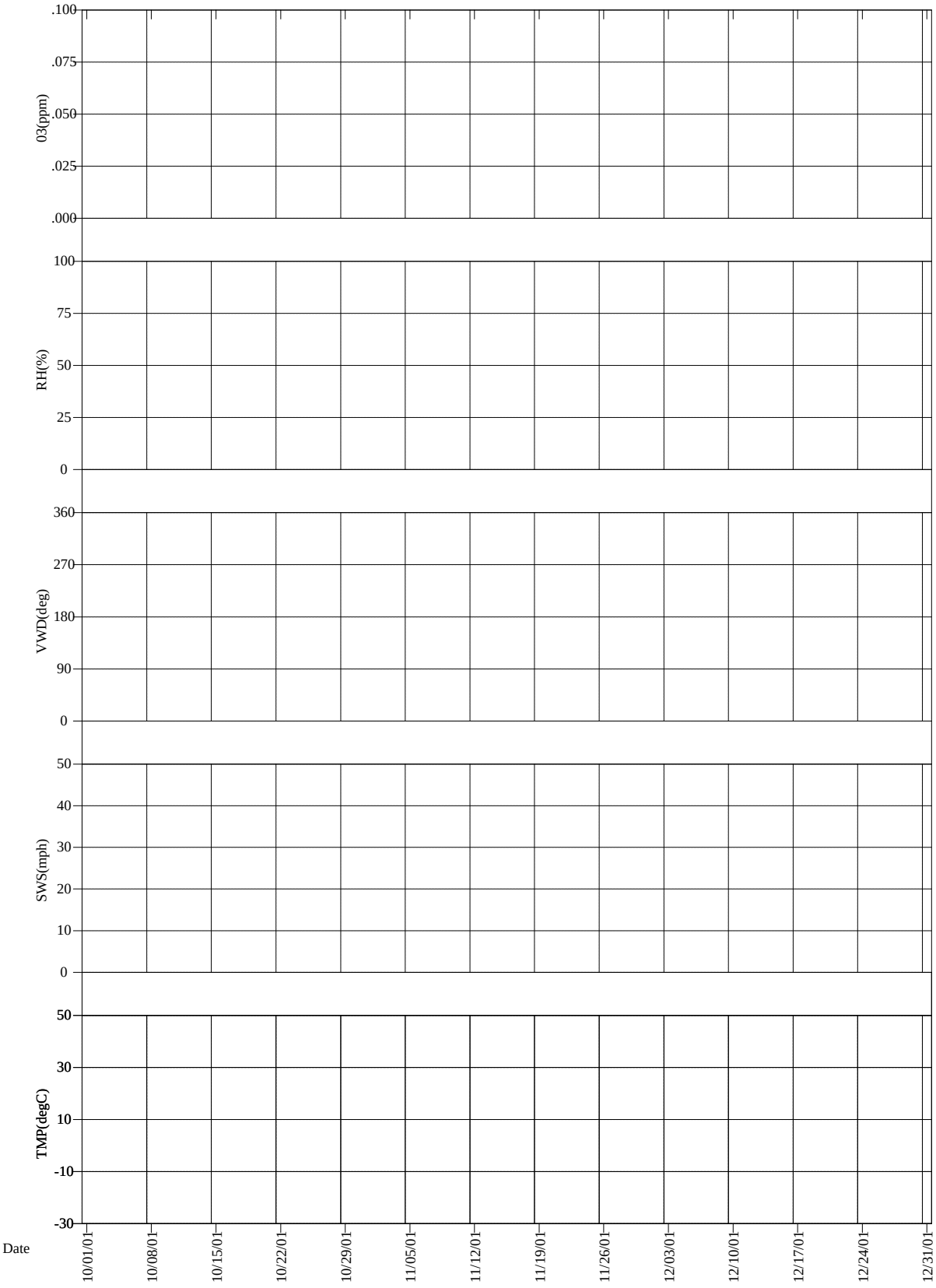
Second Quarter 2001



Final Validation

Third Quarter 2001

Acadia National Park - Cadillac Mountain



Final Validation

Fourth Quarter 2001

2.2 OZONE DATA SUMMARY

Ozone Quick Look Annual Summary Statistics
Acadia National Park
Cadillac Mountain
01/01/2001 - 12/31/2001

STATISTIC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MAY-SEP	ANNUAL
DAILY 1-HR MAXIMUM				52	108	116	120	105	96				120	120
NO. OF DAYS				(3)	(31)	(30)	(31)	(31)	(30)				(153)	(156)
AVERAGE DAILY MAXIMUM				51	59	63	55	58	47				56	56
NO. OF DAYS				(3)	(31)	(30)	(31)	(31)	(30)				(153)	(156)
MAXIMUM DAILY MEAN				48	80	74	84	75	74				84	84
NO. OF DAYS				(3)	(31)	(30)	(31)	(31)	(30)				(153)	(156)
AVERAGE DAILY MEAN				46	47	46	42	44	36				43	43
NO. OF DAYS				(3)	(31)	(30)	(31)	(31)	(30)				(153)	(156)
MAX PEAK:MIN RATIO				1.485	6.313	3.308	3.136	3.000	2.969				6.313	6.313
NO. OF DAYS				(3)	(31)	(30)	(31)	(31)	(30)				(153)	(156)
AVERAGE PEAK:MIN RATIO				1.268	1.673	1.952	1.757	1.741	1.733				1.770	1.761
NO. OF DAYS				(3)	(31)	(30)	(31)	(31)	(30)				(153)	(156)
MAX 9AM-4PM AVERAGE				50	79	81	94	89	76				94	94
NO. OF DAYS				(3)	(30)	(29)	(31)	(31)	(30)				(151)	(154)
MONTHLY 9AM-4PM AVERAGE				48	47	46	43	44	37				43	43
NO. OF DAYS				(3)	(30)	(29)	(31)	(31)	(30)				(151)	(154)
MAX 7AM-7PM AVERAGE				49	81	80	91	82	75				91	91
NO. OF DAYS				(3)	(31)	(30)	(31)	(31)	(30)				(153)	(156)
MONTHLY 7AM-7PM AVERAGE				47	47	46	43	44	37				43	43
NO. OF DAYS				(3)	(31)	(30)	(31)	(31)	(30)				(153)	(156)
MONTHLY MEAN				46	47	47	42	44	37				43	43
NO. OF HOURS				(72)	(708)	(684)	(706)	(702)	(684)				(3484)	(3556)
SUM0 EXPOSURE INDEX				3327	33547	31904	29467	30899	24987				150804	154131
NO. OF HOURS				(72)	(708)	(684)	(706)	(702)	(684)				(3484)	(3556)
SUM60 EXPOSURE INDEX				-	7713	11377	7164	6300	3847				36401	36401
NO. OF HOURS				(0)	(102)	(150)	(95)	(88)	(51)				(486)	(486)
SUM80 EXPOSURE INDEX				-	3149	4205	2262	1714	1146				12476	12476
NO. OF HOURS				(0)	(36)	(46)	(23)	(19)	(13)				(137)	(137)
W126 EXPOSURE INDEX				275	7621	9268	6227	5652	3625				32392	32667
NO. OF HOURS				(72)	(708)	(684)	(706)	(702)	(684)				(3484)	(3556)

Concentrations in parts per billion (ppb)
Exposures in parts per billion-hours (ppb-hr)

* Statistics defined in the Quick Look subsection of the Glossary

Final Validation

5/7/02

Frequency Distribution

Acadia National Park
Cadillac Mountain
Monitoring Season: 04/01/01 - 09/30/01 [1]

Averaging Period	% Obs.[3]	# Obs.[2]	Min. Obs.[4]	Percentile[5] 10	30	50	70	90	95	99	Max. Obs.	2nd Max.	Arith. Mean	Geo. Mean	Geo. Stdv.
1-Hour	85	3556	0.025	0.034	0.045	0.050	0.061	0.092	0.101	0.117	0.120	0.117	0.0562	0.0529	1.41

Concentrations in parts per million (ppm)

[1]Records for this report are selected in accordance with the AIRS Geo-Common file criteria. These criteria are based on the state-specific Monitoring Season defined in AIRS.

[2]The number of observations (# Obs.) includes all valid observations recorded within the Monitoring Season.

[3]The percent of valid observations (% Obs.) is the percentage of valid days to the number of possible monitoring days during the Monitoring Season. A valid day is defined as a day with 9 or more valid observations between 9:00 a.m. and 9:00 p.m..

[4]The minimum observation value (Min. Obs.) is the minimum daily maximum recorded during the Monitoring Season.

[5]The percentiles and other statistics are derived from the daily maximums.

Ozone Standards Report and
Daily Maximum 1-Hour Concentrations (ppm)

Acadia National Park

Cadillac Mountain

01/01/2001 - 12/31/2001

Day	Jan-01	Feb-01	Mar-01	Apr-01	May-01	Jun-01	Jul-01	Aug-01	Sep-01	Oct-01	Nov-01	Dec-01
1	M	T	T	S	.075 T	.044 F	.077 S	.047 W	.046 S	M	T	S
2	T	F	F	M	.083 W	.049 S	.040 M	.105 T	.033 S	T	F	S
3	W	S	S	T	.090 T	.049 S	.054 T	.072 F	.038 M	W	S	M
4	T	S	S	W	.070 F	.050 M	.057 W	.060 S	.052 T	T	S	T
5	F	M	M	T	.048 S	.045 T	.061 T	.062 S	.048 W	F	M	W
6	S	T	T	F	.046 S	.027 W	.059 F	.098 M	.042 T	S	T	T
7	S	W	W	S	.050 M	.044 T	.069 S	.069 T	.095 F	S	W	F
8	M	T	T	S	.062 T	.051 F	.062 S	.046 W	.096 S	M	T	S
9	T	F	F	M	.058 W	.045 S	.053 M	.081 T	.079 S	T	F	S
10	W	S	S	T	.062 T	.048 S	.053 T	.096 F	.041 M	W	S	M
11	T	S	S	W	.087 F	.082 M	.067 W	.039 S	.037 T	T	S	T
12	F	M	M	T	.108 S	.075 T	.047 T	.045 S	.034 W	F	M	W
13	S	T	T	F	.101 S	.092 W	.038 F	.054 M	.046 T	S	T	T
14	S	W	W	S	.046 M	.109 T	.034 S	.039 T	.028 F	S	W	F
15	M	T	T	S	.039 T	.094 F	.031 S	.040 W	.035 S	M	T	S
16	T	F	F	M	.042 W	.086 S	.038 M	.056 T	.044 S	T	F	S
17	W	S	S	T	.048 T	.043 S	.048 T	.053 F	.050 M	W	S	M
18	T	S	S	W	.049 F	.057 M	.034 W	.053 S	.049 T	T	S	T
19	F	M	M	T	.046 S	.116 T	.039 T	.050 S	.034 W	F	M	W
20	S	T	T	F	.045 S	.105 W	.038 F	.066 M	.032 T	S	T	T
21	S	W	W	S	.046 M	.039 T	.059 S	.063 T	.035 F	S	W	F
22	M	T	T	S	.048 T	.050 F	.095 S	.065 W	.048 S	M	T	S
23	T	F	F	M	.050 W	.039 S	.120 M	.082 T	.054 S	T	F	S
24	W	S	S	T	.050 T	.041 S	.117 T	.051 F	.061 M	W	S	M
25	T	S	S	W	.055 F	.045 M	.066 W	.028 S	.059 T	T	S	T
26	F	M	M	T	.056 S	.072 T	.033 T	.034 S	.058 W	F	M	W
27	S	T	T	F	.056 S	.072 W	.029 F	.056 M	.038 T	S	T	T
28	S	W	W	.049 S	.070 M	.070 T	.038 S	.051 T	.027 F	S	W	F
29	M		T	.052 S	.064 T	.044 F	.049 S	.040 W	.025 S	M	T	S
30	T		F	.051 M	.048 W	.092 S	.049 M	.044 T	.045 S	T	F	S
31	W		S		.032 T		.049 T	.050 F		W		
Valid Days	0	0	0	3	31	30	31	31	30	0	0	0
Maximum	.000	.000	.000	.052	.108	.116	.120	.105	.096	.000	.000	.000
Violations	0	0	0	0	0	0	0	0	0	0	0	0

3556 Total Samples	0 Daily-maxima exceeding the standard of .12 ppm (starred[*])	
40.7 % Possible	0 Missing days assumed to be less than the standard	
156 Valid daily maxima	0 Daily maximas exceed the alert level of .200 ppm	Concentrations in parts per million (ppm)

Final Validation

7/11/02

Acadia National Park
Cadillac Mountain
2001 Attainment Status With U.S. Environmental Protection Agency (EPA)
PRIMARY Ozone National Ambient Air Quality Standard

Ozone Season: April through September

The primary National Ambient Air Quality Standard for ozone is designed to protect human health. The level of the primary ozone standard promulgated by the EPA on July 18, 1997 is 0.08 parts per million (ppm) [80 parts per billion, (ppb)], daily maximum 8-hour average. The primary ozone standard is met at an ambient monitoring site when the 3-year average of the annual fourth-highest daily maximum 8-hour average ozone concentration is less than or equal to 0.08 ppm. This standard is not met when the 3-year average is greater than 0.08 ppm. Using the EPA's rounding convention, a computed 3-year average ozone concentration of 0.085 ppm (85 ppb) is the smallest value that is greater than the level of the 0.08 ppm standard.

The primary standard requires 90 percent data completeness, on average, during the 3-year period, with no single year within the period having less than 75 percent data completeness. This data completeness requirement would have to be satisfied in order to determine that the standard has been met at a monitoring site. However, calendar years with less than 75 percent data completeness are included in the computation if the annual fourth-highest daily maximum 8-hour concentration is greater than the level of the standard. A site could be found not to have met the standard with less than complete data. The percent data completeness is the percent of valid ozone monitoring days. A day is valid if valid 8-hour averages are available for at least 75 percent of possible hours in the day (i.e., at least 18 of the 24 averages). An 8-hour average is considered valid if at least 75 percent (or 6) of the hourly averages for the 8-hour period are available.

The table below lists the 3-year average fourth-highest daily maximum 8-hour ozone concentration based on data collected during the reported year and the two previous years. This is the number to compare to the level of the new primary standard. The 3-year average data completeness percent and the reported year highest five daily maximum 8-hour averages are also tabulated. A 'No' in the Data Comp % Met? column indicates EPA data completeness requirement was not met for the three-year period.

Year	3-Year Avg 4th High Daily Max 8-hr Ozone (ppb)	3-Year Avg Data Complete %	Data Complete % Met?	Annual 1st High Daily Max 8-hr Ozone (ppb)	Annual 2nd High Daily Max 8-hr Ozone (ppb)	Annual 3rd High Daily Max 8-hr Ozone (ppb)	Annual 4th High Daily Max 8-hr Ozone (ppb)	Annual 5th High Daily Max 8-hr Ozone (ppb)
2001	89	90%	Yes	107	102	101	101	94

Ozone Analyzer 10 Highest Daily 1-Hour Average Maximum Concentrations Acadia National Park Cadillac Mountain Final Data 01/01/2001 - 12/31/2001			
Value	Date	Hour	Concentration (ppm)
Ozone Analyzer			
1	07/23/2001	19	0.120
2	07/24/2001	16	0.117
3	06/19/2001	19	0.116
4	06/14/2001	1	0.109
5	05/12/2001	21	0.108
6	06/20/2001	0	0.105
7	08/02/2001	19	0.105
8	05/13/2001	0	0.101
9	08/06/2001	20	0.098
10	08/10/2001	12	0.096**

** This value was also recorded on one or more days later in the reported period.

Episodes with 1-Hour Ozone Concentrations
≥ 100 ppb and > 124 ppb

Acadia National Park
Cadillac Mountain

01/01/2001 - 12/31/2001
FINAL VALIDATION

Site	Date	Beginning Hour	No. Hours ≥ 100 ppb	No. Hours >124 ppb	Max (ppb)
ACAD-CM	05/12/01	19	4	0	108
ACAD-CM	05/13/01	0	1	0	101
ACAD-CM	06/14/01	0	2	0	109
ACAD-CM	06/19/01	18	5	0	116
ACAD-CM	06/19/01	23	1	0	110
ACAD-CM	06/20/01	0	3	0	105
ACAD-CM	07/23/01	17	5	0	120
ACAD-CM	07/24/01	14	5	0	117
ACAD-CM	08/02/01	19	3	0	105
		Total	29	0	120

Note: The primary and secondary national ambient air standard for ozone that applied in 1996 is 0.12 ppm over a one hour period not to be exceeded more than once per year. (A value greater than .12 ppm, 124 ppb, or 235 ug/m³ exceeds the standard.) (40 CFR 50.9 with reference to Appendix D and H.)

Episodes with 8-Hour Average Ozone Concentrations > 84 ppb Acadia National Park Cadillac Mountain 01/01/2001 - 12/31/2001 FINAL VALIDATION				
Site	Date	Start and End Time of Daily Maximum 8-Hour Average > 84 ppb (hr)	Daily Maximum 8-Hour Average (ppb)	Number of 8-Hour Averages > 84 ppb During the Day
ACAD-CM	05/03/01	13 - 20	85	2
ACAD-CM	05/12/01	17 - 00	101	6
ACAD-CM	06/19/01	17 - 00	107	11
ACAD-CM	06/20/01	00 - 07	94	4
ACAD-CM	07/23/01	15 - 22	101	9
ACAD-CM	07/24/01	11 - 18	102	9
ACAD-CM	08/02/01	15 - 22	87	5
ACAD-CM	08/10/01	09 - 16	88	5
ACAD-CM	09/08/01	16 - 23	87	6
	9	Days with 8-hour average concentrations > 84 ppb		

Note: This table presents episodes of high ozone based on running 8-hour averages. In 1997, the EPA published new primary and secondary national ambient air quality standards for ozone based on 8-hour average ozone concentrations. Attainment of the new primary standard is reached if the annual fourth highest daily maximum 8-hour ozone concentration, averaged over three years, does not exceed 0.08 ppm (84 ppb or 157 ug/m^3).

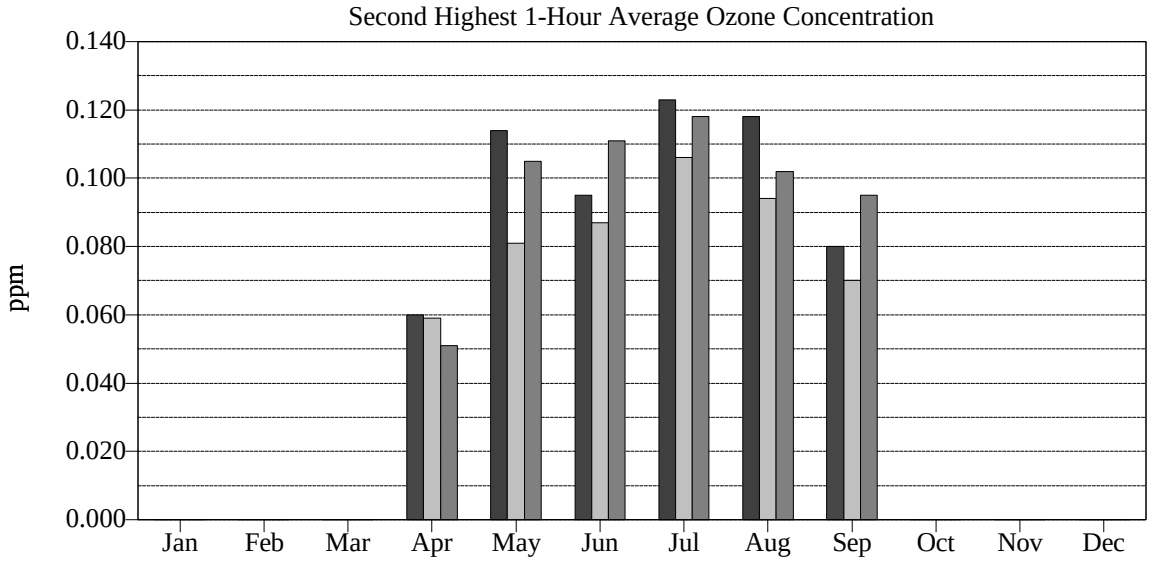
Ozone Rank Listings of Second Highest 1-Hour Average Concentrations, 4th Highest 8-Hour Average Concentrations, and Annual SUM60 Exposure Index for All NPS Monitoring Sites

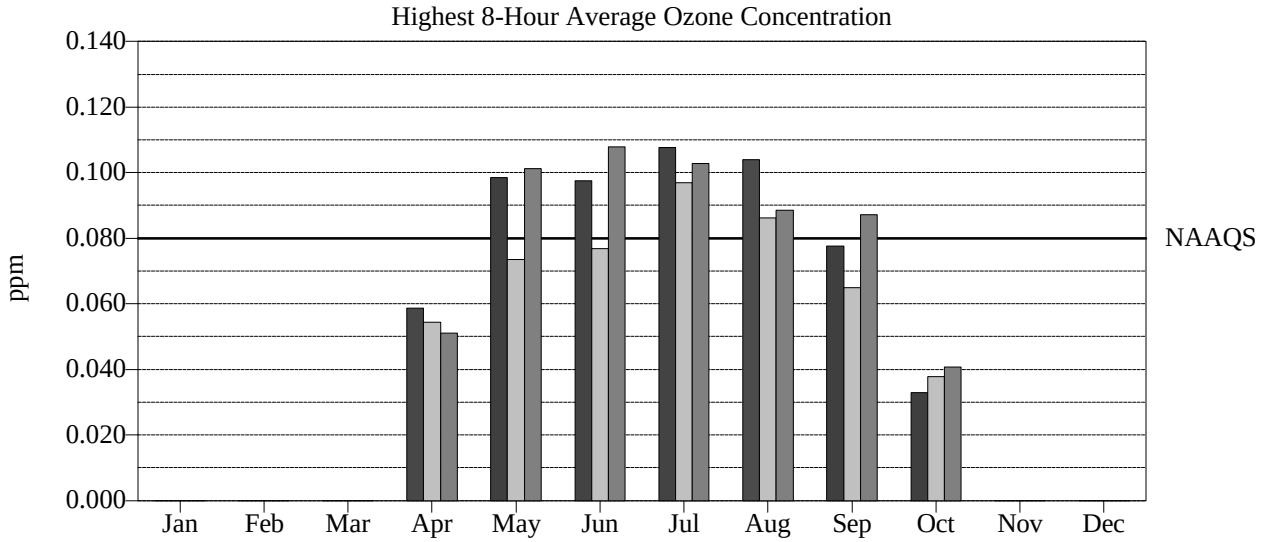
01/01/2001 - 12/31/2001

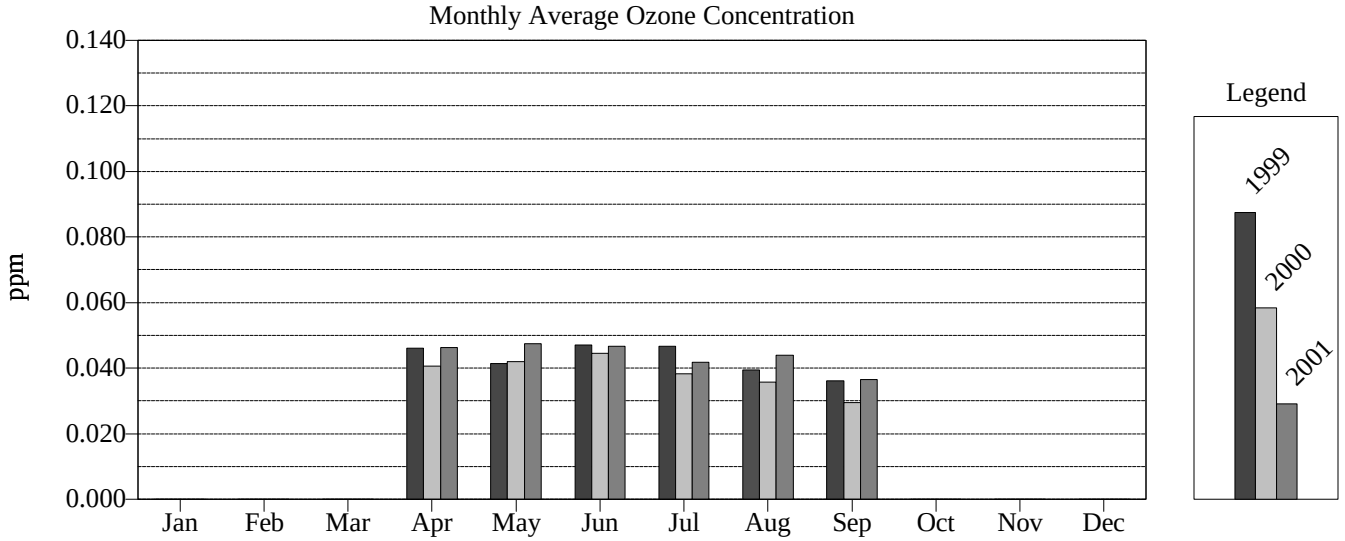
Second Highest 1-Hour Average Concentration		
Site	Rank	Concentration (ppb)
CACO-XX	1	139
CHAM-XX	2	127
SEKI-AS	3	119
ACAD-CM	4	118
SEKI-LP	5	117
ACAD-MH	6	112
GRSM-CD	7	110
COSW-BL	8	109
COWP-XX	9	109
SEKI-LK	10	108
YOSE-TD	11	107
GRSM-CM	12	105
SHEN-BM	13	104
JOTR-YV	14	100
PINN-ES	15	100
MACA-HM	16	95
GRSM-LR	17	93
DEVA-PV	18	92
GRSM-PK	19	92
GRSM-CC	20	88
ROMO-LP	21	84
LAVO-ML	22	83
GRBA-MY	23	80
MEVE-MY	24	76
YELL-WT	25	76
SAGU-PC	26	75
CHIS-XX	27	74
MORA-TW	28	74
BIBE-KB	29	73
GRCA-AS	30	73
VOYA-SB	31	73
CANY-IS	32	72
EVER-BC	33	72
CHIR-ES	34	71
CRMO-VC	35	69
DENA-HQ	36	63
THRO-VC	37	63
NOCA-MM	38	58
GLAC-WG	39	55
OLYM-VC	40	54
VIIS-LP	41	52
HAVO-TH	42	43

4th Highest 8-hour Average Concentration		
Site	Rank	Concentration (ppb)
CACO-XX	1	105
SEKI-AS	2	104
ACAD-CM	3	101
SEKI-LP	4	101
SEKI-LK	5	96
ACAD-MH	6	94
GRSM-CD	7	93
GRSM-CM	8	91
SHEN-BM	9	90
YOSE-TD	10	87
GRSM-LR	11	86
GRSM-PK	12	83
DEVA-PV	13	81
COWP-XX	14	80
JOTR-YV	15	80
MACA-HM	16	80
PINN-ES	17	79
COSW-BL	18	76
CHAM-XX	19	75
GRSM-CC	20	75
LAVO-ML	21	73
GRCA-AS	22	70
ROMO-LP	23	70
CHIR-ES	24	67
GRBA-MY	25	67
CANY-IS	26	66
SAGU-PC	27	66
YELL-WT	28	66
MEVE-MY	29	65
CHIS-XX	30	64
BIBE-KB	31	62
VOYA-SB	32	62
EVER-BC	33	60
MORA-TW	34	59
THRO-VC	35	58
CRMO-VC	36	56
DENA-HQ	37	55
GLAC-WG	38	49
NOCA-MM	39	48
OLYM-VC	40	45
VIIS-LP	41	43
HAVO-TH	42	37

Annual Sum60 Exposure Index			
Site	Rank	Sum60	Count
SEKI-AS	1	183484	2389
GRSM-CM	2	165410	2388
SEKI-LP	3	154722	2066
SEKI-LK	4	154150	2115
GRSM-CD	5	124707	1798
DEVA-PV	6	107113	1614
GRSM-LR	7	106526	1564
SHEN-BM	8	102234	1488
YOSE-TD	9	86002	1259
GRSM-PK	10	72157	1075
CACO-XX	11	47572	637
MACA-HM	12	44974	664
JOTR-YV	13	42646	621
COWP-XX	14	38829	561
PINN-ES	15	38574	558
GRCA-AS	16	36890	581
ACAD-CM	17	36401	486
COSW-BL	18	33550	491
GRSM-CC	19	33513	497
LAVO-ML	20	32438	489
ACAD-MH	21	31322	425
GRBA-MY	22	30094	474
CHAM-XX	23	22235	322
MEVE-MY	24	21689	345
CANY-IS	25	20183	321
ROMO-LP	26	19803	306
SAGU-PC	27	19230	295
YELL-WT	28	17146	273
CHIR-ES	29	16673	265
CHIS-XX	30	8340	131
BIBE-KB	31	5243	82
VOYA-SB	32	3415	53
EVER-BC	33	3256	52
MORA-TW	34	2910	45
THRO-VC	35	1893	31
CRMO-VC	36	827	13
DENA-HQ	37	687	11
NOCA-MM	38	122	2
GLAC-WG	39	0	0
HAVO-TH	40	0	0
OLYM-VC	41	0	0
VIIS-LP	42	0	0


Second Highest 1-Hour Average Ozone Concentration
ppm
0.140
0.120
0.100
0.080
0.060
0.040
0.020
0.000
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec

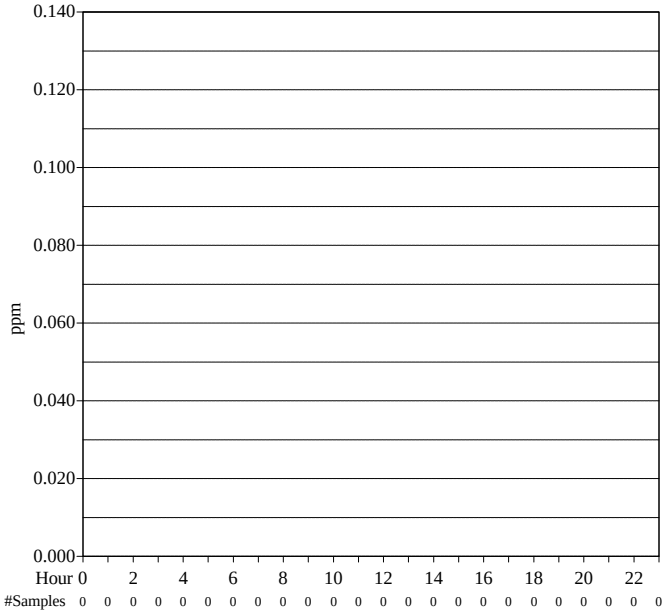

Highest 8-Hour Average Ozone Concentration
ppm
0.140
0.120
0.100
0.080
0.060
0.040
0.020
0.000
NAAQS
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec


Monthly Average Ozone Concentration
ppm
0.140
0.120
0.100
0.080
0.060
0.040
0.020
0.000
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Legend
1999
2000
2001

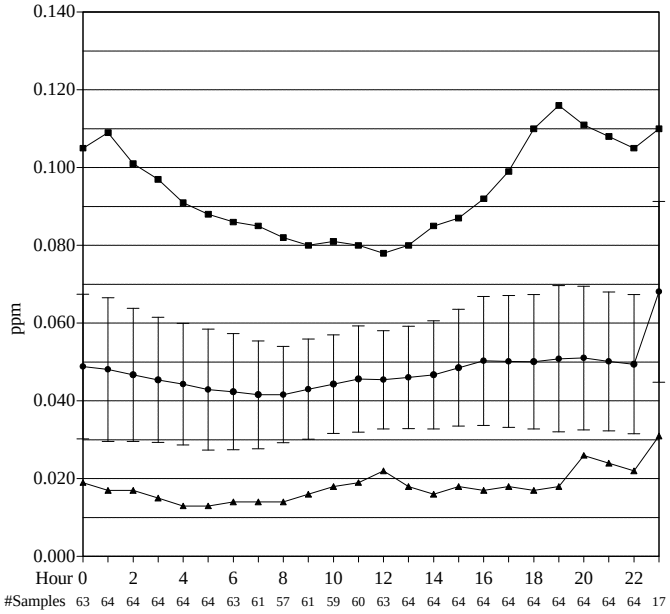
NATIONAL PARK SERVICE
GASEOUS POLLUTANT MONITORING NETWORK

2001 Second Highest 1-Hour Ozone Concentrations

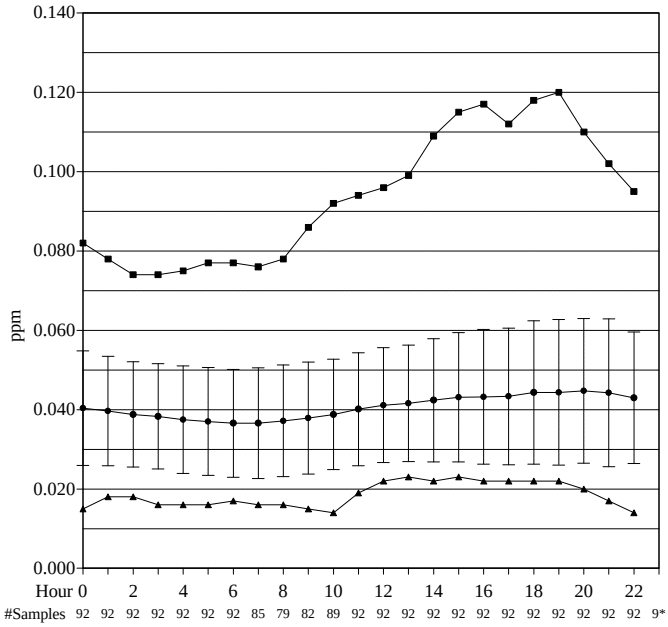
FIRST QUARTER (JAN-MAR)



SECOND QUARTER (APR-JUN)

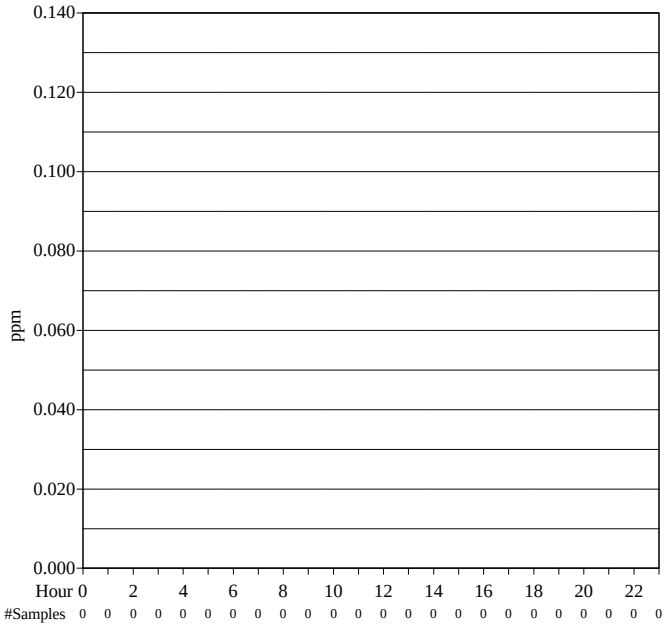


THIRD QUARTER (JUL-SEP)



* Number of samples < 20% of maximum available hours during period

FOURTH QUARTER (OCT-DEC)

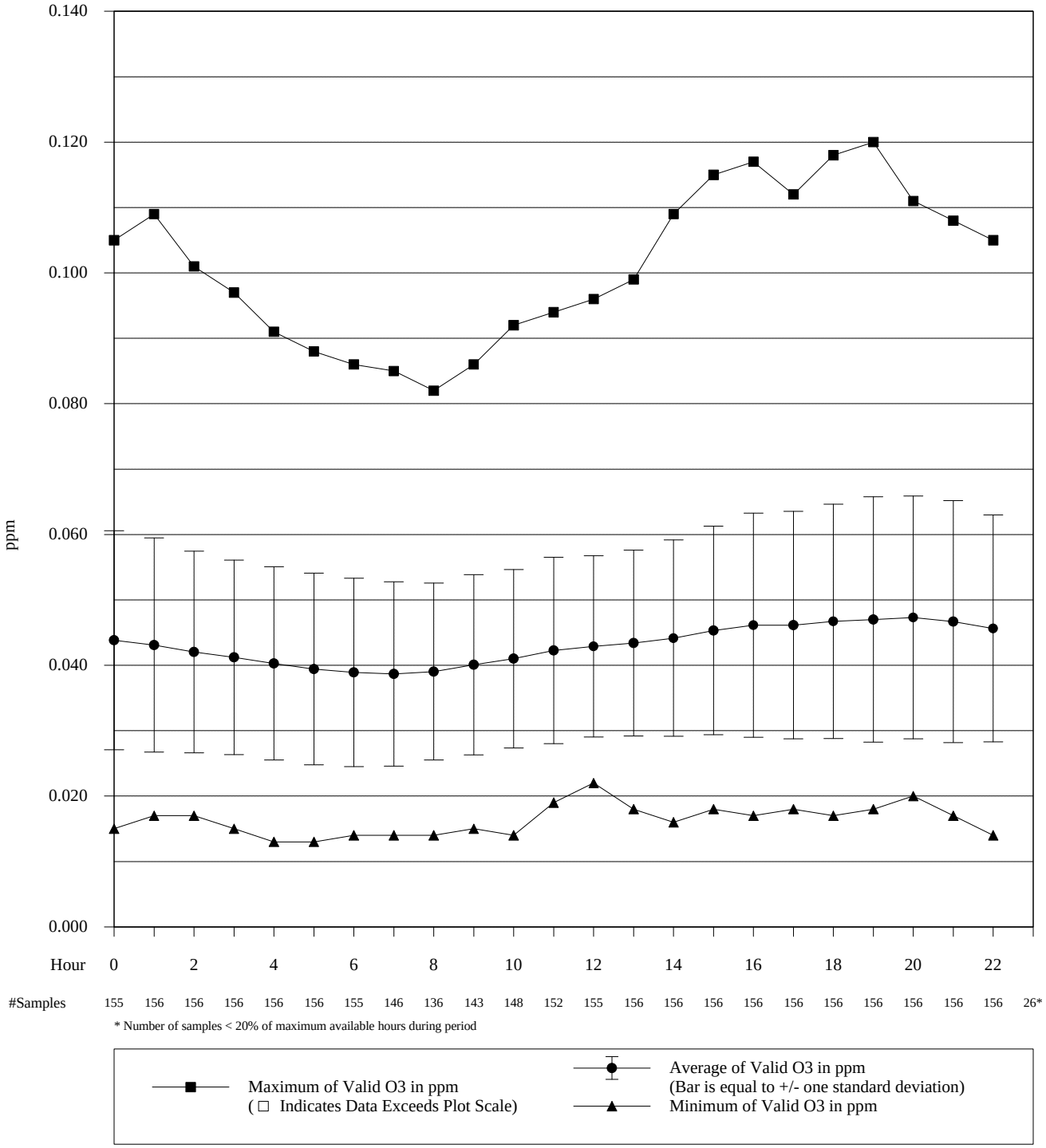


Maximum of Valid O3 in ppm
(▫ Indicates Data Exceeds Plot Scale)

Average of Valid O3 in ppm
(Bar is equal to +/- one standard deviation)

Minimum of Valid O3 in ppm

Annual Diurnal
Plot

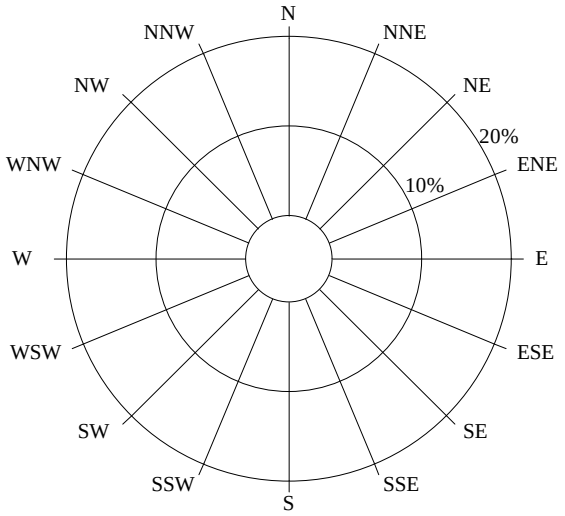


Acadia National Park
Cadillac Mountain

Quarterly Ozone
Pollutant Rose

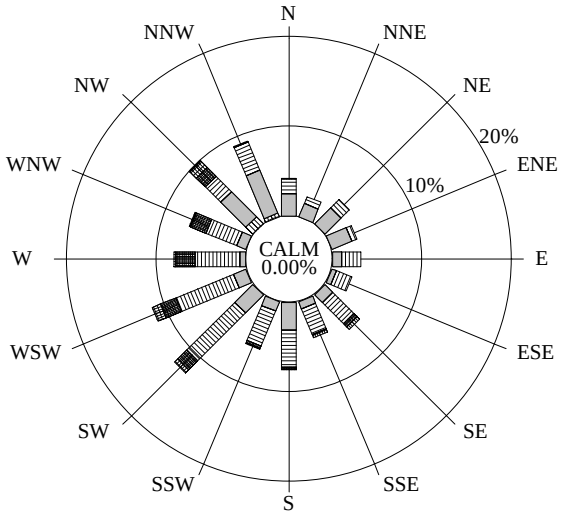
2001

FIRST QUARTER (JAN-MAR)



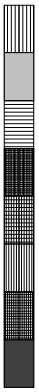
0.0% Collected 0.0% Valid
0 Possible /0 Collected /0 Valid
(includes WS and WD)

SECOND QUARTER (APR-JUN)



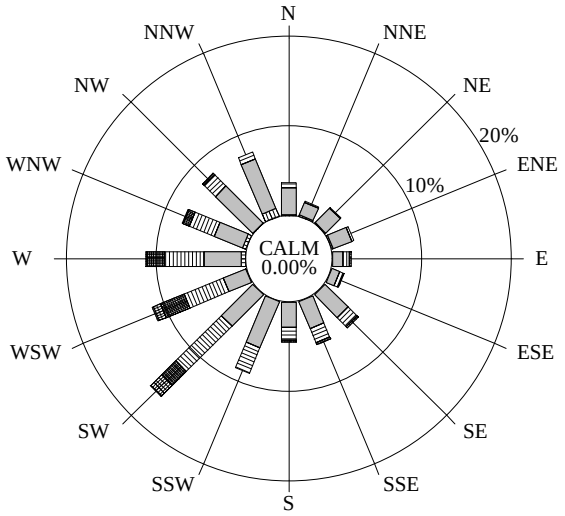
96.3% Collected 45.3% Valid
2184 Possible /2103 Collected /989 Valid
(includes WS and WD)

Ozone (ppb)



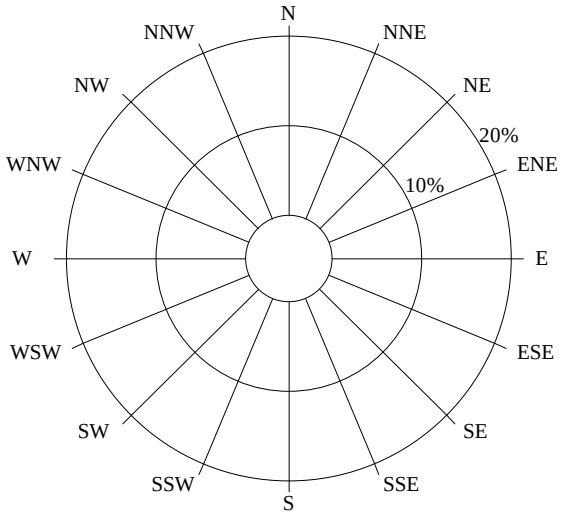
0-19
20-39
40-59
60-79
80-99
100-119
120-139
140+

THIRD QUARTER (JUL-SEP)



90.7% Collected 85.5% Valid
2208 Possible /2003 Collected /1888 Valid
(includes WS and WD)

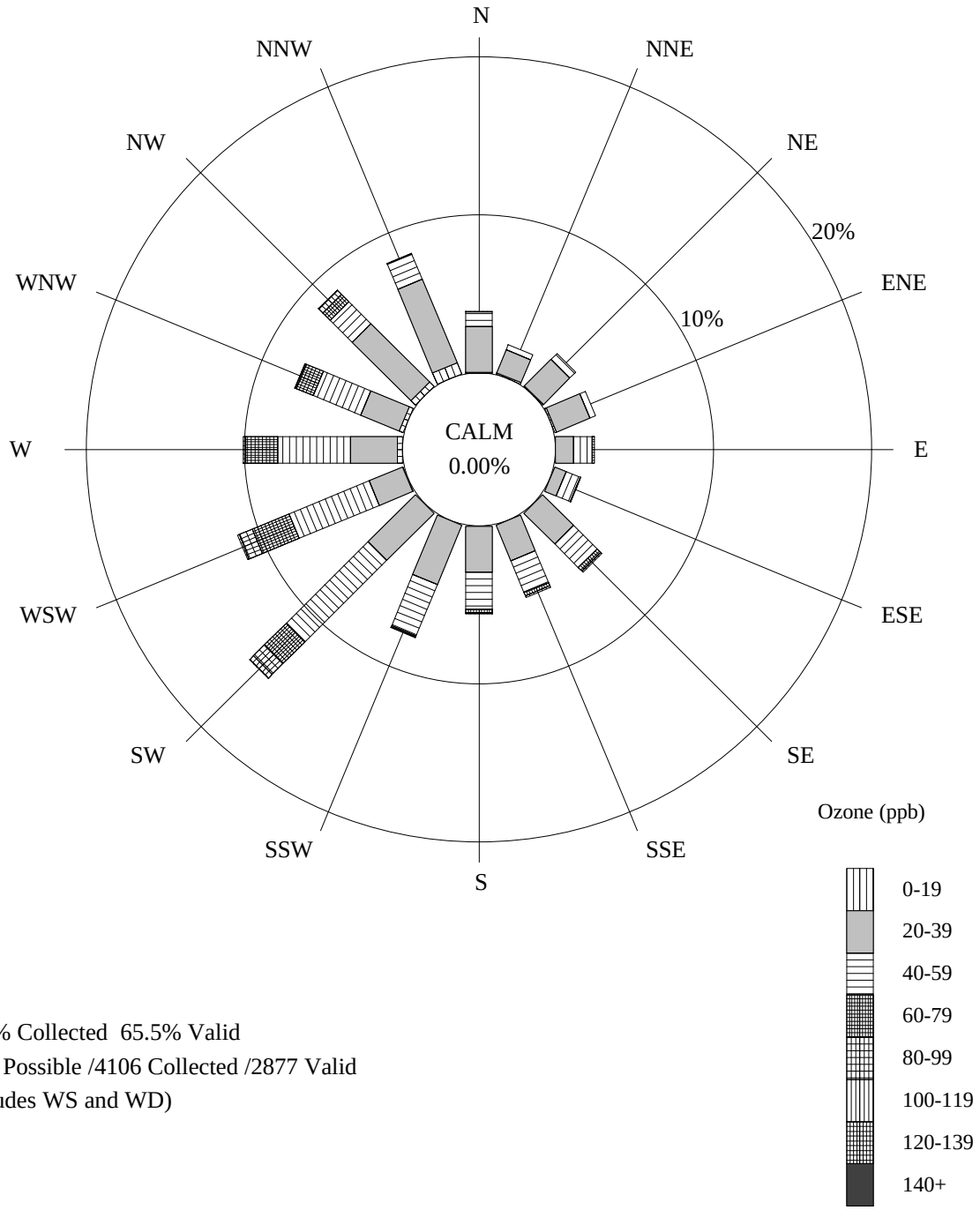
FOURTH QUARTER (OCT-DEC)



0.0% Collected 0.0% Valid
0 Possible /0 Collected /0 Valid
(includes WS and WD)

Final Validation

07-25-2002



93.5% Collected 65.5% Valid
4392 Possible /4106 Collected /2877 Valid
(includes WS and WD)

Ozone Precision Check Summary

Acadia National Park
Cadillac Mountain

Precision checks are required by the Environmental Protection Agency (EPA) of all monitoring instruments collecting data which are to be submitted to the EPA Aerometric Information Retrieval System (AIRS). A precision check is performed by challenging the pollutant analyzer with a known concentration of gas (between 0.08 and 0.10 ppm for ozone and sulfur dioxide) from the pollutant transfer standard. This precision check must be performed at least every 14 days of monitoring operation. The percent difference between the analyzer and the transfer standard is then calculated.[1] According to NPS Standard Operating Procedures, the pollutant analyzer must respond within 10% of the transfer standard. The table below gives the number of precision checks performed during each quarter, the average[2] of all the individual precision check percent differences for the quarter, and the upper and lower 95% probability limits[3] for precision checks. The probability limits represent the interval having a 95% chance of containing the true average percent difference. The quarterly average percent difference and probability limits should ideally be within +/- 10%.

Final Validation 01/01/2001 - 12/31/2001				
Calendar Quarter	Number of Precision Checks	Average Percent Difference [1] [2]	Lower 95% Probability Limit [3]	Upper 95% Probability Limit [3]
1	0			
2	8	0.50	-2.82	3.83
3	5	-0.00	-2.41	2.40
4	0			

[1] Percent Difference= $\frac{\text{analyzer - transfer std}}{\text{transfer std}}$ X 100.

[2] Average Percent Difference is the mean of all individual precision check percent differences during the quarter.

[3] Upper/Lower 95% Probability Limits=(Average Percent Difference) +/- (1.96)(Standard Deviation of precision check percent differences in the quarter.)

2.3 METEOROLOGICAL DATA SUMMARY

Summary of Selected Meteorological Data

Acadia National Park

Cadillac Mountain

Final Validation

01/01/2001 - 12/31/2001

Parameter	Value	Units	Number	Std Dev
SCALAR WIND SPEED				
Average	6.2	m/s	3552	2.8
Maximum	16.5	m/s		
Percent calm = 0.00				
AMBIENT TEMPERATURE				
Average	15.4	degC	2438	5.6
Maximum	31.7	degC		
Minimum	0.2	degC		
RELATIVE HUMIDITY				
Average	72	percent	2621	24
Maximum	100	percent		
Minimum	7	percent		
PRECIPITATION (Rainfall or Snow melt)				
Average non-zero rate	NA			
Maximum non-zero rate				
Minimum non-zero rate				
Accumulated during period				
SOLAR RADIATION				
Average Daily Total	NA			
Maximum Daily Total	NA			
Minimum Daily Total	NA			

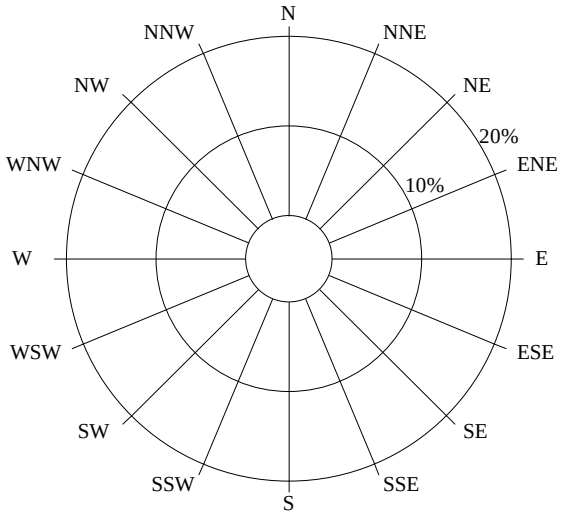
Note: Calms are included in the average scalar wind speed and are defined as winds less than 0.5 m/s (1.0 mph).

Solar radiation terms are based on the calculation of the total amount of solar energy incident on a unit area during each day. The maximum and minimum daily totals are selected from the list of daily totals. The totals for all days are then added and divided by the number of days to yield the average daily total. Only days with 24 valid values are included in these statistics.

NA indicates instrument not available.

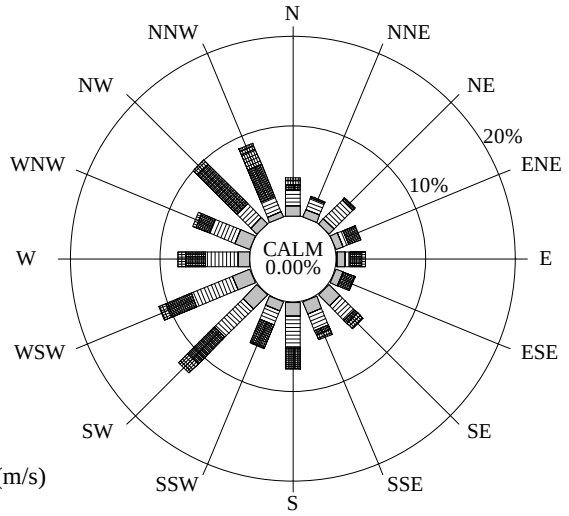
Acadia National Park Quarterly Wind Rose 2001
Cadillac Mountain

FIRST QUARTER (JAN-MAR)



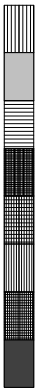
0.0% Collected 0.0% Valid
0 Possible /0 Collected /0 Valid
(includes WS and WD)

SECOND QUARTER (APR-JUN)



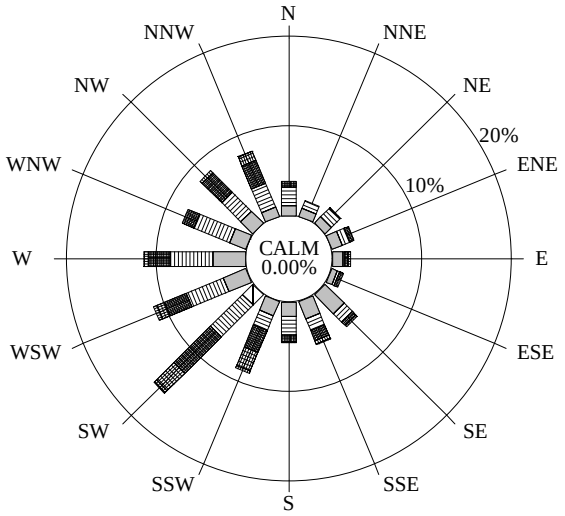
99.5% Collected 47.7% Valid
2184 Possible /2172 Collected /1041 Valid
(includes WS and WD)

Scalar Wind Speed (m/s)



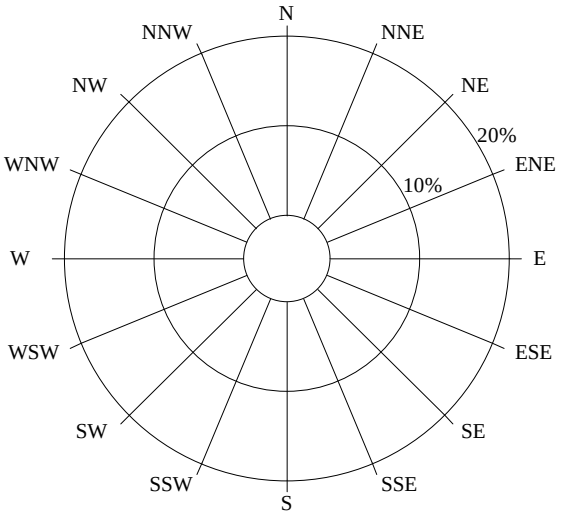
CALM < .5
0.5-0.9
1.0-3.9
4.0-6.9
7.0-9.9
10.0-12.9
13.0-15.9
16.0-18.9
19.0+

THIRD QUARTER (JUL-SEP)



95.7% Collected 90.1% Valid
2208 Possible /2112 Collected /1989 Valid
(includes WS and WD)

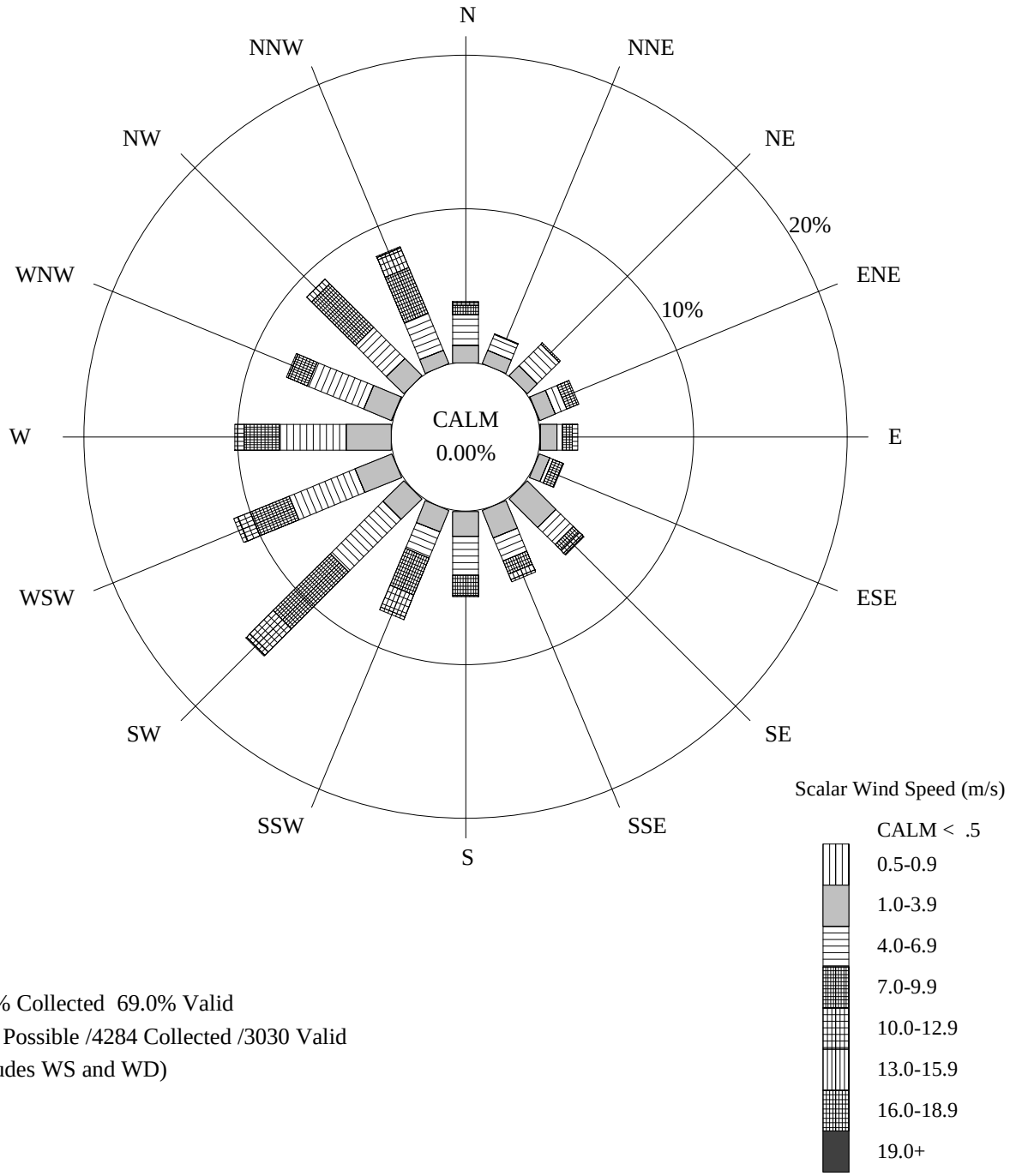
FOURTH QUARTER (OCT-DEC)



0.0% Collected 0.0% Valid
0 Possible /0 Collected /0 Valid
(includes WS and WD)

Final Validation

08-07-2002



97.5% Collected 69.0% Valid
4392 Possible /4284 Collected /3030 Valid
(includes WS and WD)

3.0 NATIONAL PARK SERVICE AIR RESOURCES DIVISION DATA SOURCES

3.1 GUIDE TO ATTACHED DATA DISKS

Data disks containing ASCII files of the validated hourly data, as shown in the following table are available. Please return the enclosed postcard or contact the address below. These data may be imported into other programs to perform additional data processing and analysis. The data format of each file is included within each file. The second table describes the validation codes used in the data tables to indicate why data are missing or invalid. Wind and pollutant frequency distribution tables in ASCII format are also included on the diskette if available for this site.

Data users should acknowledge the National Park Service Air Resources Division whenever using these data or any portion of this report.

3.2 OTHER SOURCES FOR RETRIEVING NATIONAL PARK SERVICE GASEOUS POLLUTANT DATA

The data contained in this report may also be obtained from the following sources:

- National Park Service AIRWeb (http://www.aqd.nps.gov/natnet/ard) - available after last quarter 1997
- EPA AIRS database
- Data requests directed to:

NPS Air Resources Division
Information Management Center
c/o Air Resource Specialists, Inc.
1901 Sharp Point Drive, Suite E
Fort Collins, Colorado 80525
Telephone: (970) 484-7941
Fax: (970) 484-3423
E-Mail: AIR-IMC@AIR-RESOURCE.COM

Data Disk Contents Summary	
File Name (s)	Description
Hourly	
ssssyy.DAT	All Validated Air Quality Data
ssssyymm.ppp	Monthly Data Summary Tables
ssssAN95.Rpp	Annual Wind and Pollutant Frequency Distribution
ssssQ195.Rpp	Quarter 1 Wind and Pollutant Frequency Distribution
ssssQ295.Rpp	Quarter 2 Wind and Pollutant Frequency Distribution
ssssQ395.Rpp	Quarter 3 Wind and Pollutant Frequency Distribution
ssssQ495.Rpp	Quarter 4 Wind and Pollutant Frequency Distribution
Where: ssss = site code yy = year mm = month ppp = air quality data parameter code AN = Annual Qn = Quarter 1-4 R = Wind Frequency distribution table	

CASTNet Weekly Species Summary Data	
File Name (s)	Description
CASTNet	
ssssCNyr.ASC	Weekly averages
Where: ssss = site code CN = CASTNet yr = year asc = ascii file	

NPS IMC AND AIRS INVALID DATA CODES				
NPS IMC VAL CODE	REASON	NEW AIRS CODE	OLD AIRS CODE	AIRS REASON
TO	Sample time out of limits	AG	9973	Sample time out of limits
IW	Instrument warmup	AL	9978	Voided by operator
OE	Operator error	AL	9978	Voided by operator
BM	Begin monitoring	AM	9979	Miscellaneous void
TL	Station temp low	AE	9971	Shelter temp outside limits
OS	Off scale	AM	9979	Miscellaneous void
EM	End monitoring	AM	9979	Miscellaneous void
LI	Local interference	AM	9979	Miscellaneous void
TH	Station temp high	AE	9971	Shelter temp outside limits
IM	Instrument malfunction	AN	9980	Machine malfunction
IN	Interference	AO	9981	Bad weather
RF	Recording system failure	AQ	9983	Collection error
NA	No data	AU	9987	Monitoring waived
PF	Power failure	AV	9988	Power Failure
PC	Precision check	AX	9990	Precision Check
ZS	Instrument zero/span check	AY	9991	QC Control Points (Zero/Span)
SA	System audit	AZ	9992	QC Audit
PA	Performance audit	AZ	9992	QC Audit
MT	Maintenance	BA	9993	Maintenance/Routine Repairs
OR	Out for repair	BA	9993	Maintenance/Routine Repairs
CA	Calibration	BC	9995	Multipoint calibration
SC	Station check	BF	9998	Precision/zero/span

4.0 GLOSSARY

4.1 DEFINITIONS AND COMPUTATIONAL PROCEDURES FOR NATIONAL PARK SERVICE QUICK LOOK ANNUAL SUMMARY STATISTICS REPORT

The National Park Service Quick Look Annual Summary Statistics Table (Page 2-8) provides ozone summary statistics for various indices computed on a monthly basis for an entire year. Growing season (generically defined to be May 1 - September 30) and annual statistics are also presented under the "MAY-SEP" and "ANNUAL" columns, respectively. All concentrations are expressed in the units of parts per billion (PPB) and exposures in parts per billion-hours (PPB-HR). The definitions for each of the statistics appearing on the Quick Look Annual Summary Table are given below.

(1) **Daily 1-Hr Maximum**. The maximum 1-hour average concentration recorded during each month, the growing season or the year regardless of the number of valid hourly observations recorded during a given day. The number in parentheses below this statistic, (N), indicates the number of days in the month, growing season, or year with valid data.

(2) **Average Daily Maximum**. The average of all Daily 1-Hr Maxima during the month regardless of the number of Daily 1-Hr Maxima recorded during the month. For the "MAY-SEP" column the average of all the Daily Maxima recorded during the growing season is given. For the "ANNUAL" column the average of all the Daily Maxima is given. N is as in (1) above.

(3) **Maximum Daily Mean**. The maximum of the valid daily means computed for each month, the growing season ("MAY-SEP" column), and the year ("ANNUAL" column). A valid daily mean is one for which 75% of the observations are available for each day, i.e., 18 hours. N is the number of days during each month, growing season, and year with at least 18 observations.

(4) **Average Daily Mean**. The average of all valid daily means for the month, the growing season ("MAY-SEP" column), and the year ("ANNUAL" column). N is as in (3) above.

(5) **Max Peak:Min Ratio**. The ratio of the Daily 1-Hr Maximum to the Daily 1-Hr Minimum. A ratio is computed only if a valid Daily Mean is computed and if the Daily 1-Hr Minimum is not equal to zero. N is the number of days with a valid Peak:Min ratio.

(6) **Average Peak:Min Ratio**. The average of all Peak:Min ratios for the month, growing season, or year. N is as in (5) above.

(7) **Max 9AM-4PM Average**. The maximum of all valid 9AM-4PM Averages computed for the month, growing season, or year. A valid 9AM-4PM Average is one which has 75% of the observations available during that time period (i.e., 6 hours. N is the number of days with valid averages.)

(8) **Monthly 9AM-4PM Average**. The average of all valid 9AM-4PM Averages for the month, growing season, or year. N is as in (7) above.

(9) **Max 7AM-7PM Average**. The maximum of all valid 7AM-7PM Averages computed for the month, growing season, or year. A valid 7AM-7PM Average is one which has 75% of the observations available during that time period, i.e., 9 hours. N is the number of days with valid averages.

(10) **Monthly 7AM-7PM Average**. The average of all valid 7AM-7PM averages for the month, growing season, or year. N is as in (9) above.

(11) **Monthly Mean**. The average of all 1-Hr ozone concentrations recorded during the month, growing season, or year. A mean is computed regardless of the number of hours with valid data. N is the number of hours with valid observations.

(12) **SUM0 Exposure Index**. The monthly sum of all hourly ozone concentrations. Units are PPB-HR. The "MAY-SEP" column sums across the months of May through September to give the cumulative exposure for the growing season. The "ANNUAL" column sums across every month to give the cumulative exposure for the year. N is the number of hours with valid observations and is the same N as in (11) above.

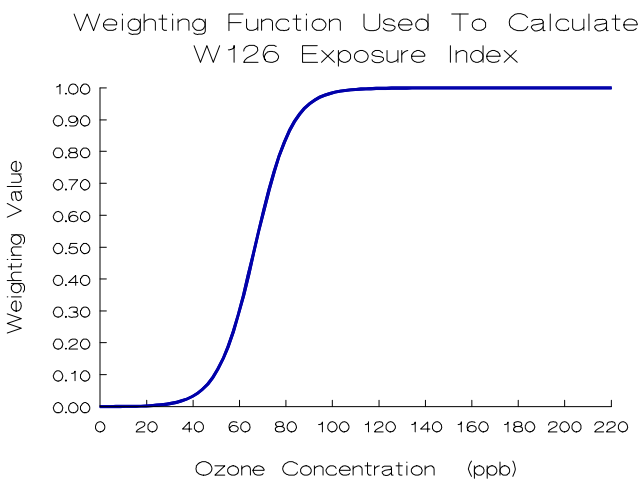
(13) **SUM60 Exposure Index**. The monthly sum of all hourly ozone concentrations equaling or exceeding 60 PPB. Units are PPB-HR. The "MAY-SEP" column sums across the months of May through September to give the cumulative exposure for the growing season. The "ANNUAL" column sums across every month to give the cumulative exposure for the year. N is the number of hours equaling or exceeding 60 PPB during the month, growing season, or year.

(14) **SUM80 Exposure Index**. The monthly sum of all hourly ozone concentrations equaling or exceeding 80 PPB. Units are PPB-HR. The "MAY-SEP" column sums across the months of May through September to give the cumulative exposure for the growing season. The "ANNUAL" column sums across every month to give the cumulative exposure for the year. N is the number of hours equaling or exceeding 80 PPB during the month, growing season, or year.

(15) **W126 Exposure Index**. The monthly sum of all hourly ozone concentrations where each concentration is weighted by a function that gives greater emphasis to the higher hourly concentrations while still including the lower ones. This weighting function provides a weighting value that is unique for each hourly ozone concentration. The weighting function, as described by Lefohn, Laurence, and Kohut[1] is:

$$w_i = \frac{1}{1 + 4403 \exp(-.126 c_i)}$$

where



w_i = weighting value for hourly concentration *i*, and
c_i = hourly concentration *i* in PPB.

The graph of weighting value versus ozone concentration, in the figure to the left, illustrates the greater weights given to higher hourly ozone concentrations.

Each hour's weighting value is multiplied by its corresponding hourly concentration. This product is summed over all the valid hours in each month to calculate the monthly W126 exposure.

Thus, the monthly W126 exposure is:

$$W126 = \sum_{i=1}^{n} w_i c_i$$

where

W126	= monthly W126 exposure index,
w_i	= weighting value for hourly concentration *i*,
c_i	= hourly concentration *i* in PPB, and
n	= number of hours in the month with valid ozone concentrations.

The "MAY-SEP" column sums across the months of May through September to give the cumulative exposure for the growing season. The "ANNUAL" column sums across every month to give the cumulative exposure for the year. The exposure units are PPB-HR.

Because each hour contributes to this exposure index, N is the number of hours with valid observations and is the same N as in (11) and (12) above.

The U.S. Environmental Protection Agency usually considers air quality statistics, such as a mean, to be "valid" (i.e., representative of the parameter being estimated for the time interval in question) only if 75% or more of the total possible observations have been measured during that time interval. Therefore, one should exercise caution when comparing these statistics between months and sites, particularly those that are <u>not</u> averages (e.g., maxima and exposures) whenever the number of valid observations is less than 75% of the total possible.

References

1. Lefohn, A.S., J. A. Laurence, and R. J. Kohut. 1988. A Comparison of Indices That Describe the Relationship Between Exposure to Ozone and Reduction in the Yield of Agricultural Crops. *Atmospheric Environment* 22, 1229-1240.

4.2 AIR QUALITY GLOSSARY

Acid Deposition: Air pollution produced when acid chemicals are incorporated into rain, snow, fog, or mist.

Aerometric Information Retrieval System (AIRS): A computer-based database of U.S. air pollution information administered by the EPA Office of Air Quality Planning and Standards (U.S. Environmental Protection Agency).

AIRWeb: Air Resources Web, an air quality information retrieval system for U.S. parks and wildlife refuges developed by the Air Resources Division of the National Park Service and the Air Quality Branch of the Fish and Wildlife Service.

Air Pollutant: An unwanted chemical or other material found in the air.

Air Pollution: Degradation of air quality resulting from unwanted chemicals or other materials occurring in the air.

Air Quality: The properties and degree of purity of air to which people and natural and heritage resources are exposed (in the context of national parks).

Air Pollution Control Permitting Process: Process by which facilities are permitted to emit specified types and quantities of air pollutants.

Air Quality Related Values (AQRVs): Values including visibility, flora, fauna, cultural and historical resources, odor, soil, water, and virtually all resources that are dependent upon and affected by air quality. "These values include visibility and those scenic, cultural, biological, and recreation resources of an area that are affected by air quality." *(43 Fed. Reg. 15016)*

Ambient Air: Air that is accessible to the public.

Class I: Areas of the country set aside under the Clean Air Act to receive the most stringent degree of air quality protection.

Class II: Areas of the country protected under the Clean Air Act but identified for somewhat less stringent protection from air pollution damage than Class I, except in specified cases.

Clean Air Act: Originally passed in 1963, our current national air pollution control program is based on the 1970 version of the law. Substantial revisions were made by the 1990 Clean Air Act Amendments.

Continuous Sampling Device: An air analyzer that measures air quality components continuously.

Criteria: Information on health and/or environmental effects of pollution (in the context of criteria air pollutants).

Criteria Air Pollutant: A group of very common air pollutants regulated by EPA on the basis of criteria and for which a National Ambient Air Quality Standard is established (SO_2, NO_2, PM_{10}, Pb, CO, O_3).

Emissions: Release of pollutants into the air from a source.

Environmental Protection Agency (EPA): The federal agency responsible for regulating air quality.

Monitoring: Measurement of air pollution.

National Ambient Air Quality Standards (NAAQS): Permissible levels of criteria air pollutant established to protect public health and welfare.

Ozone (O_3): A criteria air pollutant that is a strong oxidizing agent, reactive with many other compounds and surfaces, and a health hazard in high concentrations. Ozone is formed by nitrogen oxides and organic compounds reacting in sunlight.

Source: Any place or object from which air pollutants are released. Sources that are fixed in space are stationary sources; sources that move are mobile sources.

Sulfur Dioxide (SO_2): A criteria air pollutant that is a gas produced by burning coal and some industrial processes.

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* Recent updates to this glossary may be found on the NPSARD AIRWeb - http://www.aqd.nps.gov/natnet/ard/glossary.htm.

4.3 GLOSSARY OF AIR QUALITY UNITS

Units Conversion Table			
Parameter Type	Multiply	By	To Obtain
Pollutant	ppm	1000	ppb
	ppm	1960	$\mu g/m^3$ Ozone (at 25°C)
	ppm	2615	$\mu g/m^3$ Sulfur Dioxide (at 25°C)
	ppb	0.001	ppm
	ppb	1.960	$\mu g/m^3$ Ozone (at 25°C)
	ppb	2.615	$\mu g/m^3$ Sulfur Dioxide (at 25°C)
	$\mu g/m^3$ Ozone (25°C)	0.0005102	ppm
	$\mu g/m^3$ Ozone (25°C)	0.5102	ppb
	$\mu g/m^3$ Sulfur Dioxide (25°C)	0.0003824	ppm
	$\mu g/m^3$ Sulfur Dioxide (25°C)	0.3824	ppb
Wind Speed	m/s	2.05	mph
	mph	0.489	m/s
Solar Radiation	ly/min	697	w/m^2
	w/m^2	0.00143	ly/min
Precipitation	mm/hr	0.0394	in/hr
	in/hr	25.4	mm/hr
Temperature	°C + 17.78	1.8	°F
	°F - 32	5/9	°C

Where:
ppm = parts per million
ppb = parts per billion
$\mu g/m^3$ = micrograms per cubic meter (at 25°C)
m/s = meters per second
mps = miles per hour
ly/min = langleys per minute
w/m^2 = watts per square meter
mm/hr = millimeters per hour
in/hr = inches per hour
°C = degrees centigrade
°F = degrees fahrenheit